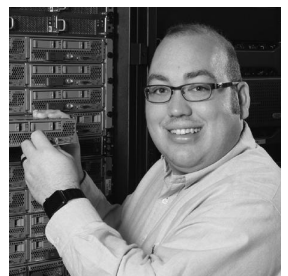
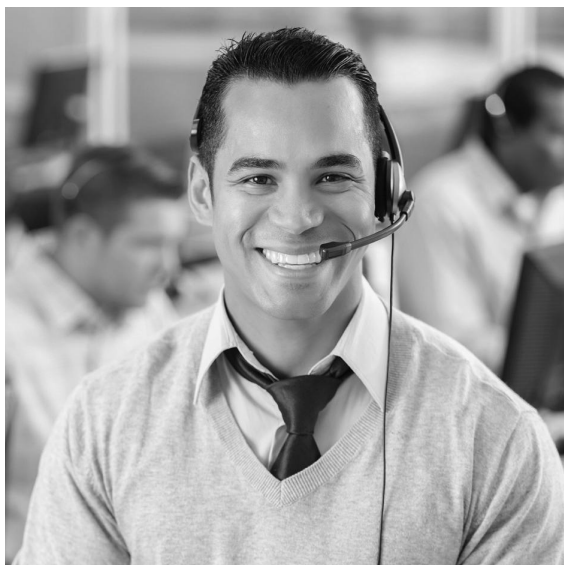
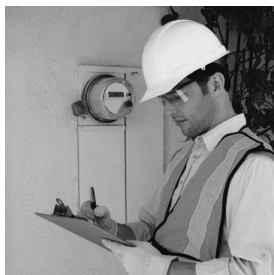


Powering America

The Economic
And Workforce
Contributions
Of The U.S. Electric
Power Industry



MJB & A

M.J. Bradley & Associates, LLC

About M.J. Bradley & Associates

M.J. Bradley & Associates, LLC (MJB&A), founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies.

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Employee photos courtesy of: American Electric Power, Arizona Public Service, Blue Ridge Energy, Bryan Texas Utilities, Dominion Energy, Georgia Power, Great River Energy, Kissimmee Utility Authority, NorthWestern Energy, and Southside Electric Cooperative.

Summary of Key Findings & Results

MEET THE FUTURE OF ENERGY



Her name is Jennifer Watters. Watters is a generation project manager who oversees major projects at American Electric Power's (AEP's) power plants, including the most recent construction of universal, or large-scale, solar power plants for Indiana Michigan Power Company (I&M). I&M is an operating unit of AEP, an electric company based in Columbus, Ohio. AEP employs about 17,600 workers, supplies electricity to 5.4 million customers in 11 states, and maintains more than 40,000 miles of transmission lines. The company's jobs range from engineer to lineworker, from truck driver to meteorologist, from customer service rep to computer programmer.

Watters' job is not unique to I&M and AEP. In fact, it is just one example of the many high-quality jobs available in the electric power industry—an industry that creates a solid, stable employment base in all 50 states and the District of Columbia, and contributes \$880 billion to the U.S. economy each year.

Watters, a 2004 graduate of Ohio Northern University, is project manager for a team that develops solar power plants for I&M from start to finish: siting, design, regulatory approval, contractor selection, and, ultimately, integrating solar power into the energy grid. "I never thought I'd be so excited to see the sun come up," she says, "but every time it does, I smile. These projects allow us to serve our customers with new sources of energy."

Powering America: The Economic and Workforce Contributions of the U.S. Electric Power Industry provides a detailed analysis of the role that electric companies—and employees like Watters—play in the nation's labor force and economy.¹ Employment opportunities are central to the economic health of our nation, and this study provides data that will help to inform federal and state policymakers and other key stakeholders as they tackle important decisions related to jobs, infrastructure, energy, capital deployment, environmental regulation, and economic growth.

FACT

Each job directly provided by the electric power industry supports an additional 1.7 jobs in our communities.

This report finds that the electric power industry directly provides nearly 2.7 million jobs across the United States through its employees, contractors and supply chain, and investments. Moreover, more than 4.4 million jobs are supported through the induced effects of these jobs. In total, the electric power industry supports more than 7 million American jobs, equivalent to about 5 percent of all jobs in the United States.

¹ M.J. Bradley & Associates (MJB&A) worked with Economic Modeling Specialists International (Emsi) to characterize the economic impacts of the electric power industry in the United States. MJB&A conducted this study on behalf of the Edison Electric Institute (EEI), the American Public Power Association (APPA), and the National Rural Electric Cooperative Association (NRECA).

Powering America



Meet Victor Daboin, a senior energy conservation specialist at the Kissimmee Utility Authority (KUA).

After graduating high school, Daboin wasn't eager to go back to school and was unsure which of his varying interests—in IT, drafting, and geographic information systems—he wanted to pursue. Eventually, his mom gave him two options: come work for KUA or enlist in the military. Daboin's mom worked for KUA, so he decided to apply to be a meter reader. He told himself that if he didn't get the job, then he'd enlist in the Navy.

Fourteen years later, Daboin still works for KUA and helps customers use energy efficiently. His role requires a three-step certification process in which candidates must demonstrate a variety of competencies; the process can take up to six years to complete. Daboin completed all three stages in just over a year. He notes that the key to success in the role is understanding the technology and equipment, which he gained working in the meter shop for six years, and being customer-service oriented.

Daboin credits KUA for allowing him to explore a variety of interests and for supportive programs that allow him to go to school while working. He is on track to complete his associate degree in fall 2017, after which he'll begin pursuing a bachelor's degree in electrical engineering.

This report reinforces that the electric power industry underpins all sectors of the economy. Understanding the industry's value, economic contributions, and changing nature is crucial to policy decisions related to employment and economic growth.

The electric power industry—including investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers—is one of the great American success stories. Thomas Edison founded the first electric company in 1881, and, since then, the industry has provided high-quality jobs and has powered our nation's economic growth with remarkable consistency.

At the same time, it is important to understand that the electric power industry of today is not the same as it was 20 years ago—or even five years ago. The industry continues to transform rapidly, and electric companies today are providing new energy solutions to meet customers' changing needs and expectations. This transformation is enabled by the industry's ongoing investment of more than \$100 billion each year to make the energy grid more dynamic, more resilient, cleaner, and more secure; to diversify the nation's energy mix; and to integrate new technologies that benefit customers.

FACT

The electric power industry
contributes \$880 billion to U.S.
GDP—5 percent
of total GDP.

The electric power industry is committed to meeting customers' needs by delivering electricity that is reliable and affordable, cleaner, and produced using a balanced energy mix that includes traditional energy resources as well as renewable ones. Today, the industry is making significant investments in diverse energy resources, including clean coal, natural gas, nuclear, solar, wind, and energy efficiency. The industry accounts for nearly all of the wind energy deployed across the country and is the largest investor in and owner of solar power. In fact, electric companies own 64 percent

of all solar in the country, and the industry's universal solar projects accounted for 72 percent of new solar capacity installed in 2016²—as Jennifer Watters' job as a solar project manager exemplifies.

Highlights

This report documents the role that the electric power industry plays in employment, wages, and the economy—both directly and indirectly.³ Highlights and key findings include:

- **Employment:** The electric power industry directly provides nearly 2.7 million jobs in communities across the United States. This includes jobs that are held by employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers, as well as contractor and supply chain and investment jobs.⁴ The industry's impact on employment is even greater when induced jobs are considered. In total, the electric power industry supports more than 7 million jobs. This means about one in every 20 jobs (or 5 percent of all jobs) in the United States depends on the electric power industry.
- **Infrastructure investment:** The electric power industry is the most capital-intensive industry in the United States.⁵ The industry operates infrastructure of breathtaking scale and complexity. In 2016, the industry's capital investments exceeded \$135 billion—a level of investment that is more than twice what it was a decade ago. These investments benefit customers and support jobs dedicated to building smarter energy infrastructure and to creating a cleaner generation fleet. Many of the individuals who support and build infrastructure projects are represented by organized labor.
- **Economic contributions:** The electric power industry directly contributed \$274 billion to U.S. Gross Domestic Product (GDP) in 2014, the latest year for which data are available. That's 1.6 percent of the nation's total economic output. In addition, the spending power of the 7 million jobs in the workforce ripples through our communities to contribute another \$606 billion. In total,

² U.S. Solar Market Insight 2016 Year in Review, GTM Research, March 2017.

³ The underlying analysis for this report was performed by Economic Modeling Specialists International (Emsi), using its proprietary Multi-Regional Social Accounting Matrix (or the Emsi model). See the Appendix for more background on Emsi's modeling approach, including a table of North American Industry Classification System (NAICS) codes used in this report.

⁴ The electric power industry provides about 491,000 jobs for employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers. In addition, the industry provides 756,000 jobs through its contractors and supply chain, and the industry's significant annual investments provide more than 1.4 million jobs.

⁵ Fitch Ratings. *U.S. Corporate Capex Study: Trends Are Relatively Flat for 2014*, Special Report. September 23, 2013.

The electric power industry
SUPPORTS

7 MILLION+
AMERICAN JOBS

2,662,000
DIRECTLY PROVIDED

4,418,000
INDUCED*



491,000
ELECTRIC
POWER
INDUSTRY
EMPLOYEES

756,000
CONTRACTORS
& SUPPLY
CHAIN

1,415,000
INVESTMENT

678,000
INDUCED BY
POWER
INDUSTRY
EMPLOYEES

959,000
INDUCED BY
CONTRACTORS
& SUPPLY
CHAIN

445,000
INDUCED
PUBLIC
SECTOR

2,336,000
ECONOMY-
WIDE RIPPLE
EFFECT

*Induced jobs are spread throughout the economy and include many positions that are the result of paycheck spending by workers and government spending to support the communities around those workers. (As an example, induced jobs can range from elementary school teachers to medical doctors to real estate professionals, not to mention the many jobs in the service economy.)

Powering America



Meet Riley Burdick, an operator for Arizona Public Service (APS).

Working 12-hour shifts, distribution operators like Burdick serve as the brains of APS' distribution system, which consists of 1.3 million meters and 29,000 miles of power lines over 34,646 square miles of service territory. It's their job to have situational awareness of the system, staying in close contact with first responders in the field so they can safely and efficiently find the cause of an outage and take the appropriate steps to restore power.

New customer and grid technologies are evolving at a rapid pace, and today's operators have to keep up. With his strong military background, Burdick is up to the challenge. Burdick spent the majority of his "working life" in the U.S. Army. His on-the-job education in the Army placed a premium on safety and leadership, and his studies in emergency and disaster management and counterterrorism at American Military University prepared him well for a job in which anything can happen.



Meet Nate Humphrey, the oldest apprentice lineworker in the history of Southside Electric Cooperative in Crewe, Virginia.

At 37, the U.S. Army veteran with more than 13 years of service as a paratrooper was considered completely disabled because of injuries that stretched from his brain to his legs, the consequences of hellish combat missions in Iraq, Afghanistan, Kosovo, and Kuwait. Humphrey served in the 82nd Airborne Division and the 25th Infantry Division, rising to the level of staff sergeant (E6). He was in seven combat deployments totaling 48 months. He was wounded in Afghanistan and in Iraq, taking shrapnel in both legs and suffering a traumatic brain injury from an improvised explosive device—a roadside bomb.

After attending an open house to learn more about the Power Line Worker School, a partnership between Virginia's community college system and its electric cooperatives, Humphrey sought a medical reevaluation and successfully worked to downgrade his disability classification. After graduation from the school's third class, Southside Electric hired Humphrey in January 2017. Humphrey started on a service truck doing calls to houses and fixing security lights before being moved to an underground crew. "I think I've found my second calling," he says. "I used to defend the country, and now I light it up."

the industry's economic impact is \$880 billion annually (approximately 5 percent of the nation's total GDP).⁶

- **Job quality:** As a whole, electric companies provide more than just good pay and good benefits. On average, employees work in the industry for more than 15 years, in careers that support their families and anchor them in their communities. In 2015, median annual wages for electric power industry employee jobs were \$73,000—double the national median. Including benefits, the industry's median annual compensation exceeds \$100,000.⁷ Often, jobs in the electric power industry fill a societal gap, helping to break the cycle of poverty in many communities.
- **Workforce development:** The electric power industry is committed to supporting employees today and to building tomorrow's energy workforce. Through the Center for Energy Workforce Development (CEWD) and partnerships with educational institutions, public workforce systems, and organized labor, the industry is working to create long-term employment solutions for a skilled, diverse workforce in the future. Of note, a majority of the skilled workforce is organized labor, and the industry works with organized labor to provide apprenticeship programs, on-the-job training, and continuing education.

FACT

The electric power industry is responsible for more than 7 million American jobs in communities large and small. From supporting new skills training to STEM education to resources for veterans, women, youth, and adults, the industry is creating long-term solutions and driving employment for a skilled, diverse workforce in the future.

⁶ Estimated based on the electric power industry's impact on sales of all U.S. industry sectors and the ratios of those industries' national sales to GDP contributions. Modeled estimates and datasets were provided by Emsi.

⁷ Salary information pertains to the electric power industry's approximately 491,000 jobs for employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers.

Economic Impact Studies Versus Surveys/Census Methods

A key difference between this report and other recent energy workforce-related reports is the approach used to estimate the job impact numbers. Two methods commonly used are census-style approaches and economic impact modeling approaches. Under a census approach, total job estimates are developed using data self-reported by the targeted industry. A census is a count of all workers said to be related in one way or another to a given industry at any given time. It does not classify how workers are employed or where jobs are located along the supply chain. It also does not estimate an industry's broader economic impact.

This report is based on an economic impact study, which explores the downstream impacts of a job in a specific industry. To model these impacts, the jobs being examined (i.e., the direct jobs) must be identified and classified carefully. The economic and employment contributions of these jobs then are modeled using information that captures the interrelationships of industries, including an industry's reported supply chain and the purchases from that supply chain. The industry's broader economic impact (induced jobs) then is estimated based on spending generated by electric power industry employee, contractor and supply chain, and investment jobs. The initial classification of direct jobs is key to ensuring there is no double counting of downstream impacts. Because census reports are a raw count of jobs without classification, they do not show an industry's downstream impact and cannot be used to generate one.

As discussed in the Appendix, this report uses official, government-collected data as a starting point for its economic impact analysis. The electric power industry jobs reported to the U.S. Bureau of Labor Statistics (BLS) form the basis for modeled investment, supply chain, and induced jobs.

Powering America



Meet Cassandra Wheeler, a plant manager for Georgia Power's Plant Hammond in northwest Georgia.

Serving in this position since May 2014, Wheeler is responsible for overseeing the safe, reliable, and efficient generation of electricity and providing overall leadership for operations for the four-unit plant. In December 2017, Wheeler will assume a new role as regional director for Georgia Power.

When preparing to graduate from high school in Mobile, Alabama, Wheeler had her sights set on attending college in the state of Louisiana. Her mom made a last-minute decision due to the cost of the college in Louisiana that changed the course of Wheeler's career.

Wheeler already had been contacted by an Air Force recruiter, who painted a picture offering independence and education. She enlisted and, after basic training, attended 10 months of technical training to become a B-1B avionics test technician. After successful completion of the training, she was assigned to the 319th Bomb Wing in Grand Forks, North Dakota, where she was one of only three women. She was promoted to Senior Airman ahead of her peers due to her leadership, job performance, and work ethic. Wheeler credits her time in the Air Force for helping prepare her for a successful career in the electric power industry.

After graduating from the University of Cincinnati with a bachelor's degree in electrical engineering, Wheeler was hired at Alabama Power in 2001. She earned her MBA at the University of Alabama at Birmingham in 2007. Since then, she has served in various leadership roles in generation throughout her 16-year career with Southern Company.



Meet Steve Leathe, hydropower compliance professional at NorthWestern Energy.

Leathe is a Massachusetts native who migrated to Montana after he graduated from the University of Maine with a degree in wildlife management. After earning a master's degree in botany from Montana State University, Leathe spent more than 28 years in various positions with the Montana Department of Fish, Wildlife and Parks before joining NorthWestern Energy in 2007, in part, to broaden his role in helping to maintain a healthy environment for the state's wildlife and its blue-ribbon trout fisheries.

- **Military hiring:** The electric power industry has a long history of employing military veterans because they have the training and skills that match those required for technical, engineering, support, and leadership positions in electric companies. Military veterans are an especially good fit for infrastructure jobs. Military veteran hiring accounted for more than 10 percent of new hires in the industry as of year-end 2014, the latest year for which data are available. The industry's Troops to Energy Jobs program, managed by CEWD, provides job opportunities for veterans, including many without a four-year college degree, and helps veterans transition from the military to rewarding energy careers. Since its creation in 2011, the Troops to Energy Jobs program has worked to streamline the hiring process for veterans, and its real-time database of available industry jobs can be mapped to skills gained in the military.

Tom Farrell, chairman, president and CEO of Dominion Energy, helped to launch Troops to Energy Jobs and said, "Through the program, dedicated, well-trained, and highly disciplined servicemen and servicewomen have a pathway toward stable, well-paying jobs in the private sector that closely fit their military skills." Farrell was raised in an Army family. He understands the difficulties and strain a career transition can put on military families. "There is no better way to honor our nation's returning veterans than by providing them with the tools they need to transition successfully to civilian life," he said. Since 2011, one out of every five new hires at Dominion Energy has been a military veteran.



With every advancement in technology, Americans are using electricity in more ways than ever. Our ever-increasing dependence on electricity underscores the vital importance of the electric power industry for our nation's security and prosperity and reinforces the role that electric companies play in improving the lives of all Americans. The bottom line: The electric power industry supports American jobs—and good ones—and powers our nation's economy.

The Electric Power Industry Generates Good Jobs

The electric power industry generates many of the best jobs in America—in traditional and in emerging areas. The industry provides employment to an exceptionally large demographic range—to both high school and college graduates, in every region of the country, and for most skill sets.

Overall, the industry offers a diverse number of careers—system operators, engineers, computer programmers, architects, lawyers, accountants, environmental researchers, cybersecurity specialists, call center employees and customer-service representatives, and many more. For example, electric companies employ meteorologists to forecast bad weather, so they can take measures to protect infrastructure and reliability. Foresters work alongside tree trimmers to keep long-distance transmission lines working, sometimes along remote, dangerous terrain. Fraud specialists fight identity theft. Nuclear engineers keep reactors running safely. Landscape architects manage storm water runoff. And electricians, lineworkers, and fieldworkers perform some of the industry's most visible jobs from bucket trucks and cranes.

Importantly, the industry's jobs are stable, which is especially vital for regions of the country where the economy may not be strong. As mentioned earlier, labor unions represent a majority of the industry's skilled workers. Many supplier firms, such as those in construction and heavy equipment, have significant union representation as well. The International Brotherhood of Electrical Workers, the Utility Workers Union of America, and affiliate members of North America's Building Trades Unions are key partners in apprenticeship programs that supply qualified workers to accomplish capital-intensive projects. Apprenticeships let workers train on the job and on the clock, providing a key employment alternative to higher education. The industry also has extensive business and supplier diversity programs that incorporate minority-owned businesses into its supply chain.

Powering America



Meet John Reinhart, demand response and technologies lead for Great River Energy (GRE), a generation and transmission cooperative based in Maple Grove, Minnesota.

As the lead engineer responsible for managing electric load, Reinhart is on the front lines of the co-op's transition to a digitally controlled system, and he's using new data and analysis tools to keep costs low for consumers while increasing the efficiency of the energy grid.

For decades, co-ops have operated demand response programs using one-way radio communication. GRE is now in the process of deploying two-way smart meters that will give Reinhart real-time data. The new system enables the adoption of new control technologies, such as smart thermostats and Wi-Fi-enabled devices.

Reinhart will use these technologies to avoid the need for new electric generating capacity. "A big shift is occurring in the utility industry, and that shift is creating big opportunities. The opportunity to make the grid more efficient, that's what's exciting about my job," says Reinhart.

Paying Talented Workers What They Deserve

Median annual wages for direct electric power industry employees were \$73,000 in 2015, the latest year for which data are available. This is twice the national average. With benefits, including health care and retirement contributions, median annual compensation exceeds \$100,000.

Nearly every job category in the industry earns a median wage of \$30 or more per hour, plus health and retirement benefits. Many of these skilled, well-paying jobs do not require a four-year college degree, unlike many other jobs with similar pay and benefits. Further, employment opportunities in the industry are expected to grow for many types of workers over the next decade.

Energy Infrastructure Projects Are Vital

The electric power industry is committed to providing safe, reliable, affordable, and increasingly clean energy to all customers. The industry also is committed to building a diverse, highly skilled energy workforce to meet customers' evolving energy needs. On average, the industry invests more than \$100 billion each year to build smarter, cleaner, and more resilient energy infrastructure.

Since Superstorm Sandy in 2012, investor-owned electric companies alone have invested more than \$175 billion in transmission and distribution systems. These investments have hardened the energy grid and support a more efficient response by electric companies following storms, natural disasters, or other events.

FACT

The electric power industry is the most capital-intensive industry in the United States. The industry's investments support jobs and make the energy grid more dynamic, more resilient, cleaner, and more secure for all Americans.

The contributions and scope of the industry's infrastructure jobs cannot be overstated for skilled trade workers. Southern Company's Plant Vogtle is a telling example. The company is investing nearly \$10 billion to build two nuclear reactors in Georgia. Southern Company partnered with North America's Building Trades Unions, creating 5,000 onsite jobs for hard-working, highly skilled craftsmen and women. When the two reactors begin operation, the plant will permanently employ 800 workers while providing 2,200 megawatts of zero-emissions energy.

Electricity Drives the U.S. Economy

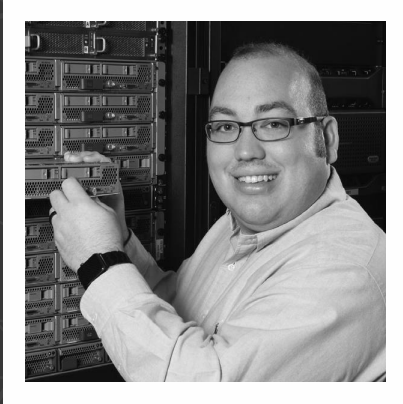
Nearly everything we do depends on an affordable and reliable supply of electricity. The electric power industry is focused on serving customers and on creating energy solutions to meet customers' changing needs. At the same time, the industry is making long-term investment and planning decisions, and is transforming the energy grid to be responsive to new resources, new technology options, and changing customer expectations.

Several trends are driving change in the industry today. Chief among them are declining costs for natural gas and renewable energy resources that are developed at scale; changing customer expectations; environmental regulations; and the growth of distributed energy resources, including energy storage, private (or rooftop) solar, microgrids, demand response, energy efficiency, and electric vehicles. How these trends continue to unfold across the nation, and how well the industry is able to work with other stakeholders, will determine the success of this transformation for customers. Ultimately, investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers all share common goals and a commitment to provide safe, reliable, affordable, and increasingly clean energy for all customers.

It is important to note that, while the industry is making significant investments, electricity remains a great value. In 2016, residential electricity's share of total consumer expenditures was only 1.4 percent, the lowest it has been in the last 58 years. This means that for every dollar of customer expenditures, less than a penny and a half went to pay electric bills.⁸

⁸ "How Low Can You Go?" daily commentary from Steve Mitnick, *Public Utilities Fortnightly*, January 31, 2017, based on Personal Consumption Expenditures data from the U.S. Bureau of Economic Analysis.

Powering America



Meet Phil Crump, a network security administrator for Blue Ridge Energy.

With increasing cybersecurity threats, Crump and many others within the electric power industry work to protect the energy grid and to safeguard critical infrastructure.

“Serving our members is also about protecting their information and safeguarding our servers and system against security breaches,” Crump says. “Hackers work overtime to disrupt the grid and steal personal identities and financial information. We all work diligently to protect the thousands of members of our community. Really, we view

every single one of those members as part of one big Blue Ridge family. And when you look at it that way, we don’t need any extra motivation to safeguard our grid, along with our members’ information.”



Meet Michele Kimich, a meter data analyst at Bryan Texas Utilities (BTU).

Technology is an ever-changing, ever-present beast full of data that is the focus of nearly all global industries. BTU realized the amount of data that new technologies can provide, and created Kimich’s position in 2015 to interpret the information to benefit the utility and its customers.

Kimich has experience taming beasts, given her degree in agricultural business and her first position as an agriculture science teacher. She became interested in analytics when she landed a job at a local

electric cooperative, first assisting large commercial accounts and then managing the billing department for nearly 10 years. It was there that she recognized that the real-time data retrieved from individual meters can help customers manage their usage, while allowing electric companies to make informed decisions regarding rates, system loads, and planning for the future.

“The meter data measures the vital signs and determines the health of a utility,” Kimich says. At any given time, she can use the interval data collected from more than 55,000 meters every 15 minutes to measure revenues, study feeder management, and examine peak consumption.

This report provides a foundation of knowledge and data to support policy decisions that create a strong economy and vibrant labor force. The report captures the deep contributions of the electric power industry to our economy and to our workforce—the industry creates and supports high-quality jobs in every state and the District of Columbia—and demonstrates how the industry’s ongoing and substantial investments

benefit communities by creating jobs, generating tax revenue, and building the smarter energy infrastructure that will power our energy future. Most important, this report reminds us that, behind every wall outlet or light switch, there is a dedicated workforce focused on powering the lives of millions of Americans who rely on electricity for nearly everything they do.



Michael J. Bradley
President and Founder
M.J. Bradley & Associates, LLC



Tom Kuhn
President
Edison Electric Institute



Sue Kelly
President and CEO
American Public Power Association



Jim Matheson
CEO
National Rural Electric
Cooperative Association

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Understanding the electric power industry's value, economic contributions, and changing nature is crucial to policy decisions related to employment and economic growth.

Michael J. Bradley
President and Founder, M.J. Bradley & Associates

Our industry is so vital to America's economy, supporting more than 7 million jobs. Often, jobs in our industry fill a societal gap, helping to break the cycle of poverty in many communities. As our society continues to become more dependent on electricity, we are creating long-term solutions to address the need for a skilled, diverse workforce to meet the future demands of our customers.

Tom Kuhn
President, EEI

The nation's more than 2,000 community-owned, not-for-profit public power utilities are proud to be a part of an industry that provides millions of jobs to hardworking Americans. Community-owned public power utilities provide local jobs that keep dollars in their communities, supporting families and representing a significant piece of our American economy.

Sue Kelly
President and CEO, APPA

Affordable and reliable electricity is the heartbeat of the American economy and is essential to the nation's economic growth. As not-for-profits owned by the members we serve, our broader purpose is to empower local communities to thrive. Co-ops are proud to continue recruiting top-tier talent from local communities as we work to meet tomorrow's energy needs.

Jim Matheson
CEO, NRECA

The electric power industry is a major driver of our economy, directly providing more than 2.7 million good jobs in communities across the nation. The IBEW is working closely with our management partners to maintain the best trained energy workforce in the nation so we as an industry can continue to support a healthy economy and good jobs.

Lonnie R. Stephenson
International President, International
Brotherhood of Electrical Workers (IBEW)

The positive economic effects of the electric power industry are felt around the country, supporting middle-class families and their communities. We're proud to partner with the industry through our Power for America program to build one of the safest, most highly trained workforces in the nation.

Mike Langford
President, Utility Workers
Union of America (UWUA)

The electric power industry is a key driver of the economy and jobs in America. The industry's infrastructure investments support jobs with strong wages and benefits for millions of Americans, including the men and women of the building trades.

Sean McGarvey
President, North America's Building Trades Unions

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Powering America:
The Economic and Workforce
Contributions of the U.S.
Electric Power Industry

Detailed Findings



INTRODUCTION

The electric power industry is responsible for more than 7 million jobs in the United States and employs workers throughout the nation in a wide variety of occupations and professions.

Our analysis finds that the electric power industry directly provides nearly 2.7 million jobs in communities across the United States. This includes jobs that are held by employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers, as well as contractor and supply chain and investment jobs.⁹

The industry's employment impact is even greater when induced jobs are considered. In total, the electric power industry supports more than 7 million jobs. This means about 1 in every 20 jobs (or 5 percent of all jobs) in the United States depends on the electric power industry.

The electric power industry directly contributes \$274 billion to the nation's Gross Domestic Product (GDP). In addition, the spending power of the 7 million jobs in the broader workforce ripples through our communities to contribute another \$606 billion.¹⁰ The total economic impact of the industry is \$880 billion, or about 5 percent of the nation's nearly \$18 trillion GDP.

The purpose of this report is to provide a deeper understanding of the electric power industry's impact on jobs and on our nation's economy. The electric power industry is committed to delivering the safe, reliable, affordable, and

3 FACTS AT A GLANCE

1. The electric power industry supports more than 7 million American jobs—about 5 percent of all U.S. jobs.
2. The electric power industry contributes about 5 percent of total U.S. GDP to the nation's economy.
3. The electric power industry is the most capital-intensive economic sector in the United States, investing more than \$100 billion each year to build smarter, cleaner, and more resilient energy infrastructure.

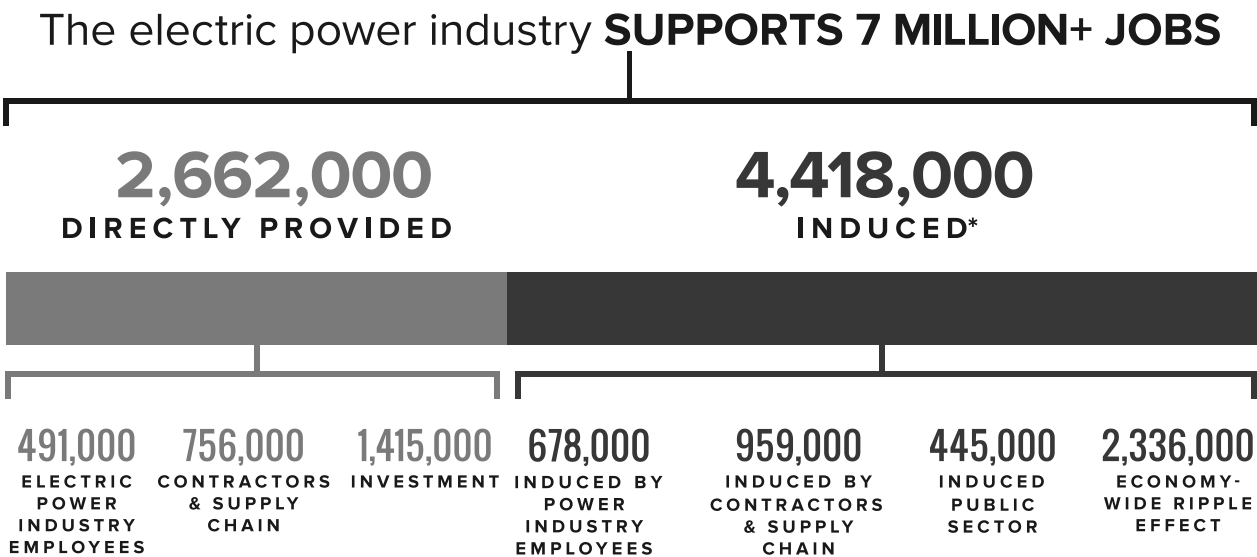
increasingly clean energy that powers America's economy and quality of life. To do so, the industry relies on a diverse set of energy resources and makes significant investments to make the energy grid smarter, cleaner, and more resilient. The industry continues to be the most capital-intensive economic sector, investing more than \$100 billion each year over and above operations and maintenance in each of the past five years.

New and changing sources of electricity supply and demand are driving significant shifts and innovation in the electric power industry. As a result, the industry is poised to have an even larger influence on employment and on economic growth as more aspects of daily life are powered by electricity.

⁹ The electric power industry provides about 491,000 jobs for employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers. In addition, the industry's contractors and supply chain provide 756,000 jobs, and the industry's significant annual investments provide more than 1.4 million jobs.

¹⁰ Estimated based on the electric power industry's impact on sales of all U.S. industry sectors and the ratios of those industries' national sales to GDP contributions. Modeled estimates and datasets were provided by Economic Modeling Specialists International (Emsi).

Figure 1. Summary of Jobs Supported by the Electric Power Industry



**Induced jobs are spread throughout the economy and include many positions that are the result of paycheck spending by workers and government spending to support the communities around those workers. (As an example, induced jobs can range from elementary school teachers to medical doctors to real estate professionals, not to mention the many jobs in the service economy.)*

Today, the industry is working to ensure that its workforce has continuous access to training to support the ongoing investment in the energy grid and its advanced and high-tech infrastructure projects. The industry also is committed to workforce diversity and continues to ensure that its workforce reflects the communities that it serves. Working in partnership with the Center for Energy Workforce Development (CEWD), organized labor, and community colleges and universities across the country, the industry has created a number of workforce development programs to meet these goals.

On behalf of the Edison Electric Institute (EEI), the American Public Power Association (APPA), and the National Rural Electric Cooperative Association (NRECA), M.J. Bradley & Associates (MJB&A) worked with Economic Modeling Specialists International (Emsi) to characterize the economic impacts of the electric power industry in the United States. CEWD also provided valuable insight and data to this analysis. This information provides detailed statistics on the size and composition of the electric power industry workforce, as well as the jobs that support the electric power industry throughout

the economy. Emsi used publicly available data as input to its proprietary input-output (I-O) model to develop the wider job and economic impact estimates.¹¹

ECONOMIC MODELING OF THE JOBS AND CONTRIBUTIONS OF THE ELECTRIC POWER INDUSTRY

In this report, we explore the economic and workforce contributions of the electric power industry in three areas: (1) annual spending on the daily operation of the existing infrastructure, including the wages paid to the highly skilled employees throughout the industry; (2) the ongoing investments in electric power generation, transmission, and distribution systems; and (3) the broader economic contributions of the industry through its supply chain and through the spending of its workers.¹² Quantifying the employment and economic contributions of the electric power industry with any precision, however, is a complex task. This report attempts to provide a multi-dimensional picture of the broad reach of the industry.

¹¹ See the Appendix for background on Emsi's modeling approach.

¹² For the purposes of this report, we have defined the electric power industry as the investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers that operate electric generating stations, whether those are coal-based or natural gas-based power plants, nuclear power plants, hydropower facilities, or wind or solar energy centers; those that maintain transmission lines; and those that distribute and deliver electricity to homes and businesses.

The jobs discussed in this report include both full-time and part-time jobs. This report does not distinguish precisely between the full-time and part-time positions, as we did not have sufficient data to do so.

Jobs Provided by the Electric Power Industry

Utilizing the economic I-O model developed and operated by Emsi, we estimate that the electric power industry supports more than 7 million jobs. These jobs are split into two primary categories: directly provided jobs and induced jobs. Each is summarized and broken down in more detail in Figure 1.

The Electric Power Industry's Directly Provided Jobs

Electric Power Industry Employee Jobs

Overall, we find that there are about 491,000 workers employed by investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers.¹³

Many of the jobs associated with the industry are well known to the public. These include lineworkers who maintain the energy grid and restore power after storms or other events, and customer service representatives who respond to customer needs. There are also many less familiar jobs and professions across dozens of disciplines. In addition, there are many employees within skilled trades—such as master electricians, heavy equipment operators, wind ops workers, solar technicians, and combustion system mechanics—many of whom are represented by labor organizations that play a critical role in job training and development.

Contractor and Supply Chain Jobs

The industry's supply chain includes skilled contractors who work side-by-side with electric power industry employees. It also includes employees of companies that produce fuel for the industry and advanced manufacturing firms that supply the tools and equipment to operate and maintain the system. **We estimate that the electric power industry's contractors and supply chain provide 756,000 jobs.** This includes jobs associated with the contractors who support the industry and the immediate supply chain to the industry. For example, these workers include those employed by natural gas production companies that provide natural gas to power

plants. Additional jobs are provided by the suppliers of the suppliers in the extended supply chain. These include, for example, the manufacturers of equipment such as valves and meters that are used by natural gas production companies. In the case of both immediate and extended supply chain jobs, the number of jobs associated with the supplying industry is apportioned based on sales to the electric power industry. In this way, for example, not all natural gas production jobs are counted as electric power industry supply chain jobs; we count only the fraction of jobs that is supported by the electric power industry's purchases.

Investment Jobs

The significant annual investments by the electric power industry to build smarter energy infrastructure and to continue the transition to even cleaner generation sources are expected to exceed \$100 billion annually for the next several years. **We estimate that level of investment provides more than 1.4 million jobs.** While these workforce impacts, including jobs associated with design and construction, traditionally are thought of on a project-by-project basis, we have endeavored to quantify the broad national economic contributions of the overall investments being made by the industry.

Capital investments made by the electric power industry benefit customers and are critical to the day-to-day reliable and secure function of the energy grid and the entire electric power system.

The Electric Power Industry's Induced Jobs

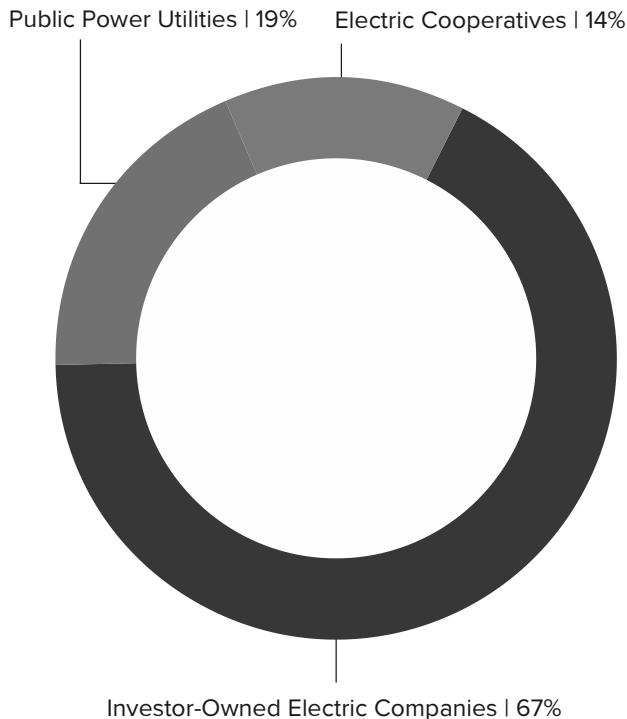
Induced Jobs

All of the jobs supported by the electric power industry—whether those jobs, for example, are electric power industry employee jobs at a power plant, contractor and supply chain jobs at a natural gas production site, or investment jobs at the construction site of a new wind energy center—result in spending that supports additional jobs in the economy. These induced jobs are spread throughout the economy and include many positions that are the result of paycheck spending by workers and government spending to support the communities around those workers. (As an example, induced jobs can range from elementary school teachers to medical doctors to real estate professionals, not to mention the many jobs in the service economy.¹⁴)

¹³ The core dataset developed by Emsi focused on employees of investor-owned electric companies and electric cooperatives. For the purposes of this report, Emsi took additional steps to estimate the workforce associated with public power organizations, which include government- and community-owned electric utilities. At the national level, Emsi estimated that jobs held by employees of these organizations accounted for about 22 percent of the industry total. The job numbers herein reflect this increase.

¹⁴ While all of the job estimates in this report include both full-time and part-time jobs, the magnitude of the industry's impact on induced jobs reflects the compensation associated with electric power industry employee jobs, contractor and supply chain jobs, and investment jobs.

Figure 2. Employment by Ownership



Source: Calculated by MJB&A based on Energy Information Administration and Federal Energy Regulatory Commission data.

We estimate that electric power industry employee jobs support 678,000 induced jobs, while contractor and supply chain jobs support another 959,000 induced jobs. Government spending of tax revenue—on schools, policing, transportation, infrastructure, and other services to support the communities where the industry operates and its employees live—results in an additional 445,000 public-sector jobs.

Moving deeper into the economy, economic modeling suggests the electric power industry employee, contractor and supply chain, and investment jobs result in further spending attributable to the industry that supports additional induced jobs. These extended impacts support an estimated additional 2.3 million induced jobs. **In total, we estimate that**

the electric power industry supports more than 4.4 million induced jobs.

A More Detailed Analysis of the Nearly 2.7 Million Jobs Directly Provided by the Electric Power Industry

Each day, the dedicated men and women who work in the electric power industry operate power plants, manage customer relations, maintain transmission and distribution systems, and carry out countless other tasks and functions that keep the energy grid running safely and reliably around the clock. These workers are employed by investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers. We refer to the positions these workers hold as electric power industry employee jobs.

Electric power industry workers in the United States are employed by a wide range of organizations. Following the conventions of the North American Industry Classification System (NAICS), and as further detailed in the Appendix, the electric power industry employee jobs represent the workforce employed by the organizations that manage the generation of electricity and organizations that transmit and distribute power.¹⁵

As noted, we estimate that there are about 491,000 electric power industry jobs provided by investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers. (See Figure 1.) As shown in Figure 2, investor-owned electric companies employ 67 percent of those workers, public power utilities employ 19 percent, and electric cooperatives employ 14 percent.

According to the U.S. Department of Energy's Energy Information Administration, the electric power industry had combined sales of more than \$390 billion in 2014.¹⁶ We estimate that these sales contributed about \$274 billion, or 1.6 percent, to national GDP. Industry sales are used to compensate employees and to invest in new energy infrastructure, as well as to pay taxes, where applicable. By modeling the sales as they move through the economy, this study estimates the impact of the electric power industry on jobs throughout the U.S. economy.

¹⁵ Many electric distribution companies in the United States are part of larger corporations that own natural gas local distribution companies. This report only considers the economic impact of electric power industry jobs. For the purposes of this report, we have defined the electric power industry as the investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers that operate electric generating stations, whether those are coal-based or natural gas-based power plants, nuclear power plants, hydropower facilities, or wind or solar energy centers; those that maintain transmission lines; and those that distribute and deliver electricity to homes and businesses.

¹⁶ Calculated by MJB&A based on Energy Information Administration Form EIA-861 "Electric power sales, revenue, and energy efficiency." Released October 6, 2016. Available at: <https://www.eia.gov/electricity/data/eia861/>.

Electric Power Industry Employees Have Good Jobs with Good Pay

The electric power industry requires a highly skilled workforce to build and maintain the energy grid and the electric power system. To attract and retain the necessary skills and talent, median annual wages for direct electric power industry employees are double the national median.¹⁷ In 2015, median annual wages for direct electric power industry workers were \$73,000, which does not include retirement plan matching programs, employer contributions to health insurance premiums, or other benefits. Including benefits, the median annual compensation exceeds \$100,000.¹⁸

According to data collected by CEWD, hiring across the electric power industry is increasing, which is expected to largely offset the industry's anticipated personnel retirements. This data further highlights hiring increases, particularly among workers between the ages of 23 and 38. In fact, since 2006, hiring of employees under the age of 37 in the key job categories tracked by CEWD has increased by more than 6 percent.¹⁹

Electric Power Industry Contractor and Supply Chain jobs

The electric power industry has more than \$1 trillion in physical assets and equipment across the country, including power plants, substations, towers, transmission and distribution lines, smart meters, transportation fleets, office facilities, and more. Operating and maintaining this complex system require a strong contractor force, which fulfills many important roles and works side-by-side with electric power industry employees. Workers across the system operate sophisticated equipment that is manufactured by skilled workers employed by advanced technology firms.

The broad range of supply chain jobs includes those jobs associated with the immediate supply chain to the electric power industry and the contractors who support it, as well as the extended supply chain: suppliers of the suppliers. We estimate that the electric power industry's contractors and supply chain comprise about 756,000 jobs. The substantial number of contractor and supply chain jobs underscores the critical role that contractors and their workers play in the industry.

More than half of the industry's contractor and supply chain jobs are the result of purchases by the electric power industry to support operations and employee jobs. For example, these include jobs associated with fuel acquisition (e.g., natural gas producers, coal miners, etc.) that are attributable to the electric power industry, as well as jobs associated with regular maintenance that are not included in the electric power industry employee jobs estimate (e.g., contractors retained to clear vegetation around power lines, manufacturers of replacement parts, etc.). In this sense, some supply chain jobs may involve similar or identical job functions as certain employee jobs, but the workers are employed by a company not captured with the government reporting for the electric power industry.

Many industries are part of the electric power industry supply chain, but only some of the jobs in those industries can be attributed to the electric power industry. For example, more than two-thirds of the natural gas produced in the United States is used to heat homes and as an input to industrial processes. In these cases, the economic model does not classify those jobs as suppliers to the electric power industry.

Other contractor and supply chain jobs are the result of purchases by companies to support contractor and supply chain jobs. For example, these include companies that supply equipment to coal mining companies and natural gas producers. They also include jobs associated with developing the equipment that contractors use to maintain properties around power plants and power lines. The supply chain also includes many professional services, such as consulting and accounting, real estate management, and building services (such as janitorial and other maintenance services).

Investment Jobs

The electric power industry's investments are enhancing our nation's electric generation, transmission, and distribution infrastructure and technology. These investments also expand and change economic impacts in communities across the country.

The owners and operators of generation, transmission, and distribution infrastructure invested approximately \$120 billion in 2014 and in 2015. Industry capital investments exceeded

¹⁷ U.S. Bureau of Labor Statistics, Occupational Employment Statistics, May 2015. Electric power industry data are available at https://www.bls.gov/oes/current/naics4_221100.htm, general data at https://www.bls.gov/oes/current/oes_nat.htm#00-0000.

¹⁸ Salary information pertains to the approximately 491,000 employees of investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers.

¹⁹ Center for Energy Workforce Development. Gaps in the Energy Workforce Pipeline: 2015 CEWD Survey Results. November 2015.

\$135 billion in 2016. The industry expects capital investments to exceed \$115 billion annually for the next several years.²⁰

The significant and diverse investments by the electric power industry require a diverse and specialized workforce. These investments create opportunities at project sites and in corporate offices for workers who provide services in finance, engineering, procurement, project management, construction oversight, and other project support services. They also create opportunities for skilled craft construction workers who work onsite to build or install new infrastructure. Jobs associated with the design and construction of new advanced technologies—such as wind, solar, and distribution equipment—are high-paying jobs.

Using the modeling tools developed by Emsi, we estimate that the broad economic impact of the electric power industry's \$120 billion capital investment in 2014 (the model year) supported more than 1.4 million jobs.²¹ (See Figure 1.) The composition of these jobs varies from year to year, but we expect that the industry will sustain a similarly high level of investment throughout the country for the next several years as the industry builds smarter energy infrastructure and deploys new, cleaner generation technologies.

An Analysis of the More Than 4.4 Million Induced Jobs Supported by the Electric Power Industry

Adding together the electric power industry employee, contractor and supply chain, and investment jobs, we find that the electric power industry directly provides nearly 2.7 million jobs. This is an impressive figure, but it only begins to quantify the total economic impact of the industry across the country.

Using its economic model, Emsi estimated the jobs that result as spending moves from electric power industry employee, contractor and supply chain, and investment jobs into the broader economy. Economists typically refer to these transactions as “induced effects” or “induced jobs,” thus capturing the broad impacts of the industry.

Estimated induced jobs are largely the result of two kinds of spending:

- **Paycheck spending:** As workers spend their paychecks, additional employment opportunities are created. For example, when a power plant operator receives a paycheck, he or she will spend some portion of those dollars on goods and services, including housing, medical care, food, and entertainment. This spending supports a portion of the jobs at various institutions, for example, nursing jobs at a hospital or part-time jobs at a coffee shop.
- **Government spending:** Every part of the economy is supported on some level by government spending. The model quantifies the impact of government spending in communities as a result of taxes paid by the industry and by workers. Spending by government supports a range of jobs, including teachers at schools and first responders at police and fire stations.

What Types of Employee Jobs Does the Electric Power Industry Provide?

As the energy grid evolves to better provide and support new technologies and services, the electric power industry increasingly requires innovative skills and knowledge from employees with experience applying advanced technology and data analytics. To attract and retain a highly skilled workforce for the future, the electric power industry has created a range of workforce development initiatives in partnership with educational institutions and organized labor. As explained later in the report, many of these initiatives are focused on developing an increasingly diverse workforce. Hiring across all positions in the industry is expected to rise in the coming years to fill gaps and respond to evolving needs in the industry.

Many of the jobs in the electric power industry can be categorized in one of four key occupations that perform the myriad of specialized tasks within the industry:

- Engineers
- Lineworkers
- Plant and field operators
- Technicians²²

²⁰ Estimates are based on capital expenditure projections provided by EEI, APPA, and NRECA. EEI estimates capital expenditures (excluding investments associated with natural gas companies) by investor-owned electric companies were \$84 billion in 2014, \$91 billion in 2015, and \$96 billion in 2016. APPA estimates capital expenditures of \$20 billion to \$25 billion annually based on an analysis of sales and generation. NRECA estimates capital expenditures averaged \$13 billion between 2010 and 2014. Based on recent trends, EEI estimates an additional \$1.5 billion in annual capital expenditures by independent power producers.

²¹ As described in the Appendix, Emsi developed this estimate using its Input-Output model, assuming the capital expenditures were part of the sales included in the model.

²² MJB&A worked with CEWD to identify these occupations and the associated jobs.

Economic Impact Studies Versus Surveys/Census Methods

A key difference between this report and other recent energy workforce-related reports is the approach used to estimate the job impact numbers. Two methods commonly used are census-style approaches and economic impact modeling approaches. Under a census approach, total job estimates are developed using data self-reported by the targeted industry. A census is a count of all workers said to be related in one way or another to a given industry at any given time. It does not classify how workers are employed or where jobs are located along the supply chain. It also does not estimate an industry's broader economic impact.

This report is based on an economic impact study, which explores the downstream impacts of a job in a specific industry. To model these impacts, the jobs being examined (i.e., the direct jobs) must be identified and classified carefully. The economic and employment contributions of these jobs then are modeled using information that captures the interrelationships of industries, including an industry's reported supply chain and the purchases from that supply chain. The industry's broader economic impact (induced jobs) then is estimated based on spending generated by electric power industry employee, contractor and supply chain, and investment jobs. The initial classification of direct jobs is key to ensuring there is no double counting of downstream impacts. Because census reports are a raw count of jobs without classification, they do not show an industry's downstream impact and cannot be used to generate one.

As discussed in the Appendix, this report uses official, government-collected data as a starting point for its economic impact analysis. The electric power industry jobs reported to the U.S. Bureau of Labor Statistics (BLS) form the basis for modeled investment, supply chain, and induced jobs.

According to CEWD's 2015 survey of the energy workforce, these four key occupations make up 44 percent of total energy industry employees.²³ Additionally, CEWD identified engineers and technicians as the roles with the highest percentage of workers over 53 years of age, and concluded that these two job categories have the potential for significant retirements in the coming years.

In response, the electric power industry is expected to have a large demand for more highly skilled workers, particularly engineers and technicians, and is preparing by developing training programs to maintain a workforce with strong technical capabilities. Although they are highly skilled, many of these positions do not require a four-year college degree. Lineworkers, plant and field operators, and technicians can enter the workforce after completing two-year training programs, or they can learn the skills they need through apprenticeship programs, often with the support of organized labor.

Engineers, lineworkers, plant and field operators, and technicians form the core of the electric power industry's workforce and are responsible for building and maintaining the complex system. The tasks that these skilled workers perform are multifaceted and broad, ranging from installing new digital smart grid technology in residential neighborhoods to refueling nuclear power plants. These jobs have an outsized impact on the economy and provide high-paying, lifetime careers to many Americans.

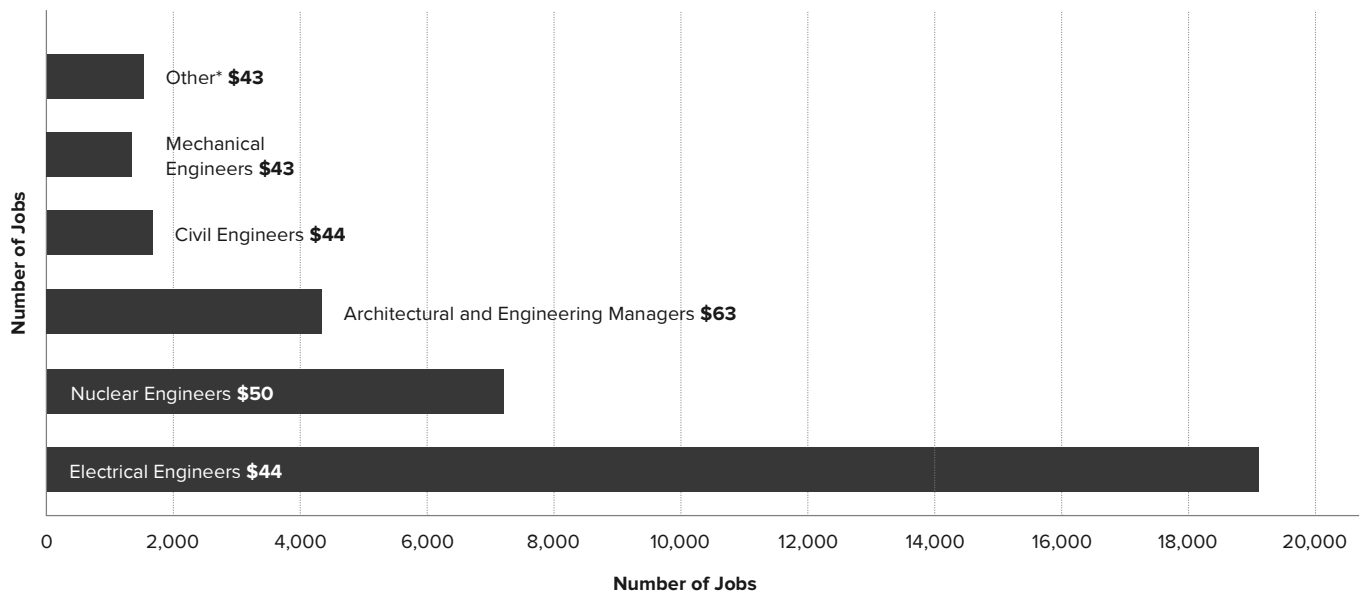
We review each of these key occupations on the next few pages.²⁴ Due to data limitations, we focus on job counts reported for investor-owned electric companies and electric cooperatives. For the purposes of this study, we assumed that public power utilities and independent power producers are structured similarly to investor-owned electric companies and electric cooperatives. In order to fully account for these key jobs, we have included jobs associated with the natural gas distribution segment in the totals.²⁵

²³ Center for Energy Workforce Development. Gaps in the Energy Workforce Pipeline: 2015 CEWD Survey Results. November 2015.

²⁴ The median hourly wage data for the following job categories are based on the same U.S. Bureau of Labor Statistics, Occupational Employment Statistics, May 2015, as was cited earlier. Electric power industry data are available at https://www.bls.gov/oes/current/naics4_221100.htm.

²⁵ A number of companies in the electric power industry also operate natural gas distribution business units. In the discussion of the key occupations, we include jobs associated with natural gas distribution, as well as electric power generation, transmission, and distribution. Natural gas distribution was not included in the economic modeling.

Figure 3. Electric Power Industry Engineering Jobs and Median Hourly Wages



*Other engineer categories include environmental, health and safety, and chemical engineers. The hourly wage displayed for the "Other" category is a weighted average of the category medians.

Engineers

More than 35,000 engineers work for electric and natural gas distribution companies. While certain types of engineers, such as civil and electrical engineers, also work in other industries, occupations such as nuclear power engineers are largely unique to the electric power industry. According to CEWD's 2015 Energy Workforce Demand report, the number of engineering jobs is projected to grow by 3.6 percent between 2014 and 2024. These jobs are highly compensated, with most median salaries higher than \$40 per hour. Figure 3 shows the distribution of engineers across the electric power industry and the median hourly wage for these jobs, which ranges from \$40 per hour for environmental engineers to \$63 per hour for architectural and engineering managers.

Lineworkers

Lineworkers are the jobs most often associated with the electric power industry and are its most visible profession. The role of the lineworker may seem straightforward: installing and repairing the power lines that crisscross America's neighborhoods and deliver electricity when and

where it is needed. However, the day-to-day tasks involved in this career are complex and challenging, ranging from restoring power in extremely challenging storm conditions, to utilizing new sources of data to identify the cause of an outage, to safely conducting electric repairs and installations while hanging 50 feet or more above the ground. Across the United States, more than 74,000 lineworkers, line mechanics, and supervisors work day and night in all conditions to keep electricity flowing safely and reliably to American homes and businesses.

According to CEWD, of the four key occupations, lineworker jobs will experience the greatest growth between 2014 and 2024, adding more than 3,500 jobs. CEWD 2015 survey data show that younger workers entering the workforce are filling lineworker positions. As of 2014, more than half of these workers were under 42 years old, and 25 percent were under 32 years old.²⁶ Figure 4 emphasizes the high-paying nature of these jobs, with both categories paying a median wage of more than \$30 per hour.

²⁶ Center for Energy Workforce Development. Gaps in the Energy Workforce Pipeline: 2015 CEWD Survey Results. November 2015.

Power Plant and Field Operators

Similar to lineworkers, plant and field operator positions are unique to the electric and natural gas generation industries. These workers, of whom there are nearly 45,000, run the power plants that provide the nation's electricity and the compressor stations that ensure natural gas is available to power plants and to customers. Information on the number of operator jobs and their compensation is found in Figure 5.

Technicians

Technicians consist of the wide range of skilled employees working in the electric power industry. These include, but are not limited to, the electricians, welders, pipefitters, machinists, and power dispatchers who keep the energy grid running safely and reliably. Technicians may work with engineers, lineworkers, and operators on a daily basis, but they are not included in any of those job categories. Information on the number of technicians and their compensation is found in Figure 6.

The Center For Energy Workforce Development: Recruiting and Training the Workforce of the Future

The electric power industry has partnered with community colleges, organized labor, and government agencies to create a range of workforce development and outreach programs that offer opportunities for individuals within local communities to gain the skills, training, and knowledge they need to pursue successful careers in the electric power industry.²⁷

In March 2006, industry stakeholders recognized the need to develop a coordinated approach to recruiting and training the energy industry workforce and launched CEWD. CEWD is a non-profit consortium of electric, natural gas, and nuclear energy companies and their associations (the Edison Electric Institute, American Public Power Association, National Rural Electric Cooperative Association, American Gas Association, and Nuclear Energy Institute).

Figure 4. Electric Power Industry Lineworker Jobs and Median Hourly Wages

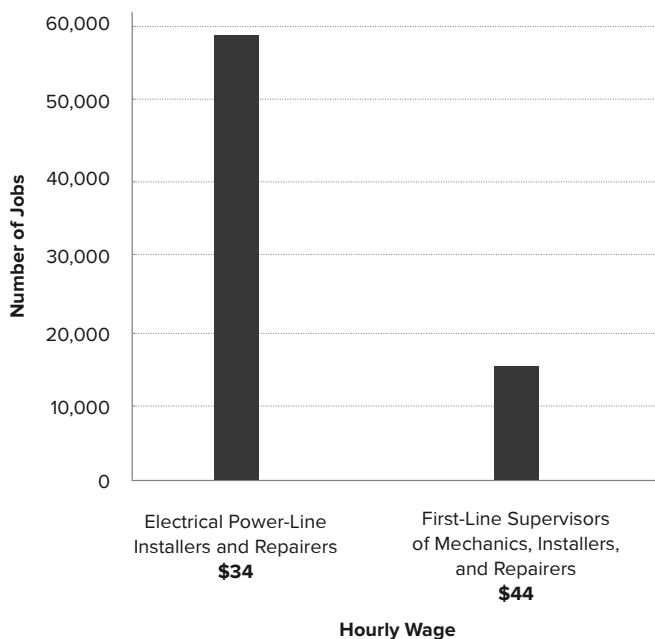
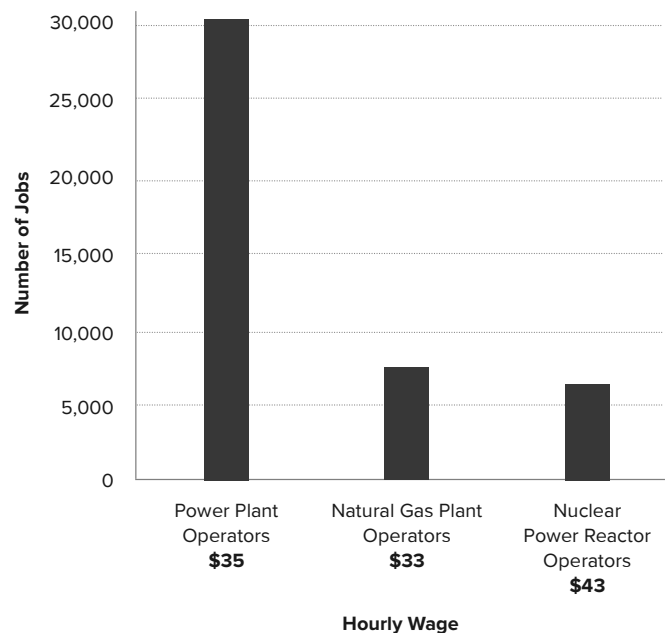
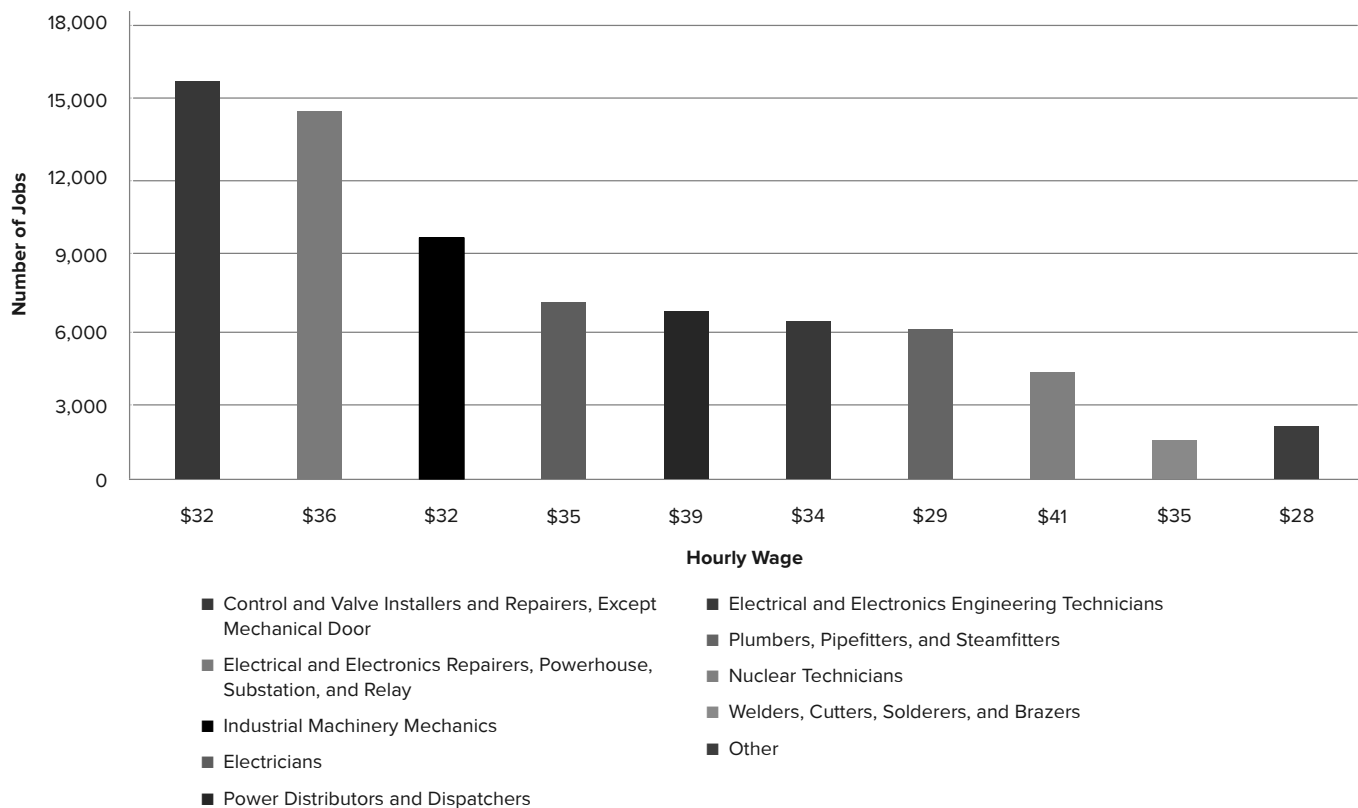


Figure 5. Electric Power Industry Power Plant and Field Operator Jobs and Median Hourly Wages



²⁷ Center for Energy Workforce Development. Gaps in the Energy Workforce Pipeline: 2015 CEWD Survey Results. November 2015.

Figure 6. Electric Sector Technician Jobs and Median Hourly Wages



*Other technician categories include pipelayers, machinists, and millwrights. The hourly wage displayed for the "Other" category is a weighted average of the category medians.

CEWD initially was created to help energy companies develop solutions to issues around an aging workforce and a potential skills shortage in the industry. It was the first partnership among companies, their associations, contractors, and labor unions to focus on the need to build a skilled workforce pipeline that will meet future industry needs.

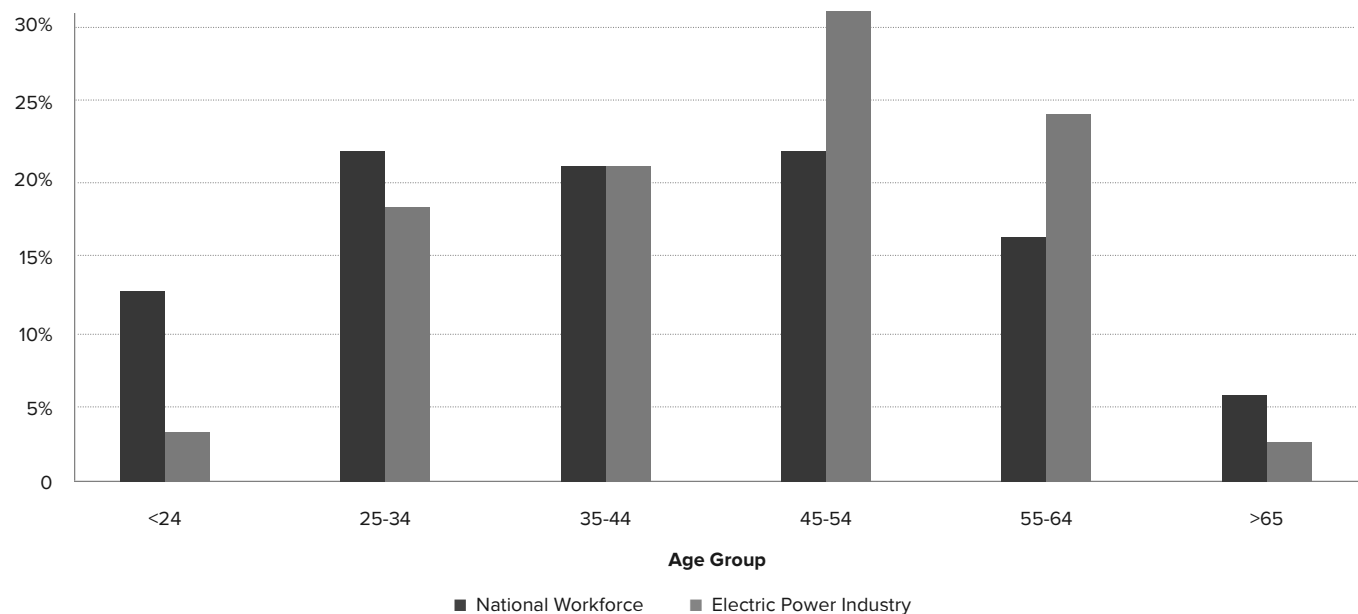
As shown in Figure 7, the electric power industry workforce continues to have a greater percentage of older workers than the total national workforce, with employees older than 45 representing 58 percent of the electric power industry workforce compared to 45 percent nationally. However, based on its surveys, CEWD has found that the energy workforce is becoming younger. In its 2015 survey of the industry, CEWD found that the number of older workers in the key jobs tracked by CEWD has declined. Between 2012 and 2014, the number of employees with the potential to retire in the next one to 10 years declined by 7.4 percentage points, with retirement

forecasts trending downward for the first time since CEWD started surveying the industry.

As the industry has implemented solutions to address concerns about an aging workforce, CEWD has extended its focus to develop approaches to close the skills gap in mission-critical jobs. No other industry has an organization like CEWD, where companies openly collaborate and share processes, technology, and results to build a trained and competitive workforce.

Since its inception, CEWD has built partnerships with multiple federal agencies and national organizations to advance energy education, career awareness, and support for critical energy jobs. A prime example is the Utility Industry Workforce Initiative that partners four federal government agencies (the Departments of Defense, Energy, Labor, and Veterans Affairs) along with organized labor and the national associations that

Figure 7. Age of the Electric Power Industry Workforce Compared to the National Workforce



are members of CEWD specifically to address workforce issues in the industry, beginning with veterans.

The federal government also has supported the development of programs to train energy industry workers. For example, the Department of Defense SkillBridge initiative provides support for programs that train service members transitioning out of the military. Southern Company's Georgia Power has developed a Transmission Line and Substation Construction Training Program that fits within the SkillBridge initiative, providing information and support, pre-employment tests, interviews, and training at Fort Stewart in eastern Georgia for apprentice lineworker jobs at Georgia Power.

Through the Troops to Energy Jobs program, CEWD and the industry have created a roadmap for veterans to enter energy careers and for companies to support the transition, retention, and professional development of military veterans working in the energy industry. Since 2010, participating energy companies have seen a steady increase in veteran hires. Overall, respondents to CEWD's 2015 survey indicated military hiring had increased from 6 percent of new employees in 2010 to slightly more than 10 percent at the end of 2014.

In total, the industry reports that veterans make up 8.1 percent of the electric power industry employee workforce. The trends in hiring and the industry's focus on military hiring and retention suggest that the number will continue to grow.²⁸

At the state level, CEWD has created State Energy Workforce Consortia that represent 30 states and embody partnerships with state agencies, educational institutions, and energy companies. The consortia work to educate students from elementary schools through universities and to provide energy career opportunities for transitioning adults, women, and low-income young adults. For example, the Virginia Energy Workforce Consortium has collaborated with the Virginia, Maryland & Delaware Association of Electric Cooperatives and Southside Virginia Community College to develop a lineworker training program. The program was developed after gathering information on workforce demand in Virginia and after identifying a need for a program that would prepare workers to assume entry-level positions and provide them with the skills necessary to join the apprenticeship process most companies already had in place. The program, which launched in spring 2016, will provide local companies with an in-state source of trained workers.

²⁸ Center for Energy Workforce Development. Gaps in the Energy Workforce Pipeline: 2015 CEWD Survey Results. November 2015.

In 2010, the Bill and Melinda Gates Foundation awarded CEWD a grant to utilize CEWD's existing state energy workforce consortia structure to implement the Get Into Energy Career Pathways Model supporting the Gates Foundation's goal to double the number of low-income young adults earning a postsecondary degree or certificate that has value in the marketplace. The Pathways Model provides a roadmap to skilled technician positions in the energy industry with pathways to higher-level jobs in a variety of work settings.

Building on the success of the Pathways Model, an educational services firm called TCI Solutions developed an approach to developing a local and diverse workforce called the Legacy I³ Model. In 2016, Xcel Energy launched a Legacy program in Minnesota. The program targeted diverse students at high schools in Minneapolis and St. Paul to encourage them to pursue positions at Xcel. Xcel's program builds on a pilot launched by Arizona Public Service in 2015 as part of the company's commitment to build a diverse talent pipeline.

CEWD has established partnerships with the International Brotherhood of Electrical Workers (IBEW) and the Utility Workers Union of America (UWUA) to advance constructive policies and to build labor-management collaborations. In addition, the IBEW has developed partnerships with several companies to develop regional training centers that will provide training to prospective workers and will update training for existing employees. The training facilities, located throughout the country, feature both classrooms and outdoor training areas that can be used to simulate work environments.²⁹

To better reflect the diversity of the communities in which it operates, the electric power industry is working with CEWD and with other organizations to increase the representation of women in the workforce, with an emphasis on introducing women to opportunities for careers in the skilled trades. At the same time, companies, government agencies, and energy industry organizations have launched programs that provide job training for underserved communities. Such

initiatives focus on building interest in the industry and providing individuals with skills that will help them to establish successful energy careers. These opportunities also may extend to the supply chain of the industry through a range of business diversity initiatives.

Conclusion

Electricity is the backbone of our economy and is crucial to our national security. Electricity powers our homes, offices, and industries; enables communications, entertainment, and medical services; runs various forms of transportation; and keeps us all connected 24/7. Today, our high-tech society demands electricity to power or charge nearly every new product or technology that comes to market.

As demonstrated through this study, the electric power industry's economic reach spreads throughout the entire American value chain. In total, the electric power industry supports more than 7 million American jobs—one out of every 20 U.S. jobs.

In addition to providing the foundation for all economic activity, the electric power industry also contributes about 5 percent of total U.S. GDP to the overall economy. And, it is the most capital-intensive industry in the United States, investing more than \$100 billion each year, on average, over and above basic operations and maintenance spending.

The value of electricity and of the electric power industry cannot be overstated. A strong workforce is essential to providing the safe, reliable, affordable, and increasingly clean energy we so often take for granted. The men and women who work in the industry are important leaders and contributors in their communities in every corner of the country.

This report is designed to help policymakers, customers, and other businesses understand the importance and complexity of this vital American success story. And, as we look to the future, we are excited about the changes the electric power industry is leading. We are confident that the resources the industry is investing to expand its training pipeline and to recruit the next generation of workers will enable the industry to continue to deliver America's energy future.

²⁹ For additional information, see: <http://www.nuitf.net/>.

Appendix: Overview of the Data Collected and Modeling Completed in Support of the Electric Power Industry Jobs Report

Economic Modeling Specialists International (Emsi) used its proprietary Multi-Regional Social Accounting Matrix (or the Emsi model) to estimate the total economic contributions of the electric power industry to the U.S. economy. The Emsi model represents the flow of money in an economy, expanding upon a more traditional input-output (I-O) approach to economic modeling. The model performs the same tasks as a traditional I-O tool, but provides a more complete picture of the economy. In addition to reporting jobs, earnings, and sales multipliers, the Emsi model provides details on the demographic and occupational components of jobs (16 detailed demographics and their spending, and about 750 career categories). The model includes more than 1,000 industry, government, household, and investment sectors.

Following is a high-level list of the sectors represented by the national matrix and the relationships among them:

- **Industry Accounts:** The activity of domestic industries
- **Owner-Occupied Dwellings:** Expenditures by people who own and occupy their own residences
- **Labor Accounts:** The earnings and expenditures of workers in certain careers
- **Capital Account:** Capital income creation and allocation of that income to resident demographic profits
- **Government Capital Account:** The depreciation of government capital and the expenditure of funds for capital replacement and maintenance
- **Tax Accounts:** Purchases of government services from taxes on production and imports
- **Investment Accounts:** Captures the source and spending of funds for current investments in the region
- **Trade Balance Account:** The account added to the matrix to handle the international trade imbalance or difference between imports and exports
- **Subsidies Account:** Moneys paid to industries from the government
- **External Account:** The exports of all sectors from the region

Focus of Electric Power Industry Modeling Effort

Any review of the workforce and economic contributions of the electric power industry starts with individuals who are employed by the industry to operate power plants, manage customer relations, maintain the transmission and distribution systems, and carry out countless other tasks and functions that keep the energy grid running safely and reliably around the clock. In this report, we refer to these jobs as electric power industry employee jobs. Electric power industry employee jobs across the economic sectors that make up the electric power industry were provided by Emsi based on its I-O Model and publicly available information.

With input from the Edison Electric Institute (EEI), American Public Power Association (APPA), and National Rural Electric Cooperative Association (NRECA), Emsi and MJB&A identified 10 industries related to the electric power industry by industrial classification code in the North American Industry Classification System (NAICS) for study. Table 1 lists the identified industries by NAICS code and provides a brief description.³⁰

For each NAICS code, Emsi compiled jobs and earnings data using information collected and published by the U.S. Bureau of Labor Statistics (BLS), and electric sector sales information using data from the U.S. Bureau of Economic Analysis' (BEA's) *Make and Use Tables and National Income and Product Accounts*. Using its model, Emsi developed statistics on employment, earnings, output (or sales), and value added (i.e., gross regional product, by industry) by industry sector. This includes the jobs associated with the supply chain, as well as jobs that are induced by the sector, such as hospitals or restaurants in communities where individuals are employed by the electric power industry.

Electric power industry workers in the United States are employed by investor-owned electric companies, public power utilities, electric cooperatives, and independent power producers. The core dataset developed by Emsi focused on employees of investor-owned electric companies and electric cooperatives.

For the purposes of this report, Emsi took additional steps to estimate the workforce associated with public power utilities, which include 2,000 government- and community-

³⁰ Many U.S. electric distribution companies are part of larger corporations that own natural gas local distribution companies. This report only considers the economic impact of electric power industry jobs (NAICS codes beginning with 2211).

owned utilities. Within the databases used by Emsi to develop the initial jobs estimates, these utilities are classified as government-related jobs. As a result, Emsi developed a methodology for estimating and reporting public power jobs using ownership data extracted from BLS Quarterly Census of Employment and Wages (QCEW).

To develop an estimate of the job impacts of the electric power industry's long-term capital investments, Emsi and MJB&A worked with EEI, APPA, and NRECA to estimate annual capital expenditures. EEI estimated capital expenditures (excluding investments associated with natural gas companies) by investor-owned electric companies were \$84 billion in 2014, \$91 billion in 2015, and \$96 billion in 2016. APPA estimated capital expenditures of \$20 billion to \$25 billion annually based on an analysis of sales and generation. NRECA

estimated capital expenditures averaged \$13 billion between 2010 and 2014. Based on recent trends, EEI estimated an additional \$1.5 billion in annual capital expenditures by independent power producers.

Using this information, Emsi estimated electric power industry capital expenditures of \$120 billion in 2014. To estimate the jobs associated with this expenditure, Emsi conducted an independent run of its model with the capital expenditures recorded as additional sales within the model. Based on this independent run, Emsi was able to isolate the impact of the capital expenditures. Within the model, that impact was captured previously as part of induced jobs. Emsi's methodology did not change the total number of jobs within the core run of the model but provided data to attribute jobs to capital expenditures.

Table 1. Electric Power Industry Sectors Included in Analysis

NAICS	Name	Description
221111	Hydroelectric Power Generation	These facilities use water power to drive a turbine and produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221112	Fossil Fuel Electric Power Generation	These facilities use fossil fuels, such as coal, oil, or natural gas, in internal combustion or combustion turbine conventional steam process to produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221113	Nuclear Electric Power Generation	These facilities use nuclear power to produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221114	Solar Electric Power Generation	These facilities use energy from the sun to produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221115	Wind Electric Power Generation	These facilities use wind power to drive a turbine and produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221116	Geothermal Electric Power Generation	These facilities use heat derived from the Earth to produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221117	Biomass Electric Power Generation	These facilities use biomass (e.g., wood, waste, alcohol fuels) to produce electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
221118	Other Electric Power Generation	These facilities convert other forms of energy, such as tidal power, into electric energy. The electric energy produced is provided to electric power transmission systems or to electric power distribution systems.
22121	Electric Bulk Power Transmission and Control	This comprises the operation of electric power transmission systems and/or controlling (i.e., regulating voltage) the transmission of electricity from the generating source to distribution centers or other electric utilities. The transmission system includes lines and transformer stations.
22122	Electric Power Distribution	This comprises electric power establishments primarily engaged in either (1) operating electric power distribution systems (i.e., consisting of lines, poles, meters, and wiring) or (2) operating as electric power brokers or agents that arrange the sale of electricity via power distribution systems operated by others.



About M.J. Bradley & Associates

M.J. Bradley & Associates, LLC (MJB&A), founded in 1994, is a strategic consulting firm focused on energy and environmental issues. The firm includes a multi-disciplinary team of experts with backgrounds in economics, law, engineering, and policy. The company works with private companies, public agencies, and non-profit organizations to understand and evaluate environmental regulations and policy, facilitate multi-stakeholder initiatives, shape business strategies, and deploy clean energy technologies.



About The Edison Electric Institute

EEI is the association that represents all U.S. investor-owned electric companies. EEI's members provide electricity for 220 million Americans, and operate in all 50 states and the District of Columbia. In addition to its U.S. members, EEI has more than 60 international electric companies as International Members, and hundreds of industry suppliers and related organizations as Associate Members.



About The American Public Power Association

The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. It represents public power before the federal government to protect the interests of the more than 49 million people that public power utilities serve, and the 93,000 people they employ. The association advocates and advises on electricity policy, technology, trends, training, and operations. Its members strengthen their communities by providing superior service, engaging citizens, and instilling pride in community-owned power.



About The National Rural Electric Cooperative Association

The National Rural Electric Cooperative Association is the national service organization representing the nation's more than 900 private, not-for-profit, consumer-owned electric cooperatives, which serve 42 million people in 47 states.